IC58

Simpson
Model 474 DMM
Service Bulletin

Smead

GENUINE PRESSBOARD COVER
SMEAD MANUFACTURING COMPANY
HASTINGS, MINN. U.S.A.

No 1 2 9

Simpson
INSTRUMENTS THAT STAY ACCURATE
CUSTOMER SERVICE

853 Dundee Avenue
Elgin, Illinois 60120
(312) 697-2260 Telex 72-2422

Pride in Service
NASM MEMBER

OEM SERVICE BULLETIN
#7-84
September 18, 1984

MODEL 474
DIGITAL MULTIMETER

NOTICE

This publication is intended solely for use by Simpson Authorized Service Centers. When this document is made available to other than Simpson Authorized Service Centers, it is done so strictly as a courtesy and does not constitute authorization to repair, calibrate, and/or in any way service Simpson products. REPRODUCTION FOR USE BY OTHERS IS PROHIBITED.

To the best of our knowledge and at the time written, the information contained in this Service Bulletin is technically correct and the procedures accurate and adequate to effect the repair and to conduct the performance tests required to assure the unit's compliance with its original advertised specifications.

Simpson Electric Company supplies this service information as a courtesy to the recipient and neither assumes nor accepts any responsibility for any personal injury or equipment damage that may occur during or as a result of tests, wherever performed, whether performed in whole or in part by the recipient of this information; persons employed by the recipient of this information; or any other person that chooses to use the information contained herein; and whether or not using tools and equipment recommended by Simpson.

WARNING

Many of the tests required to troubleshoot, repair, and calibrate this equipment are inherently hazardous. Therefore, troubleshooting, repairing, and calibrating must be performed only by Simpson Authorized Service Centers, and if any such Service Center fails to put the equipment in satisfactory condition, then the factory (National Service Manager) should be promptly notified.

NOTE: Tolerances referenced in the calibration information are the original manufacturer's calibration specification which are maintained on new equipment to assure compliance with the unit's advertised specifications. Repairing equipment used in the field in a wide variety of environments (over a period of time) to these specifications may not be practical or necessary because of cost. However, it is essential that the advertised specifications as given in the operator's manual be met after repairs are made.

SAFETY INFORMATION

Certain Caution and Warning notes are included in appropriate places in this bulletin. These notes are posted as a reminder to Service Personnel to adhere to safe service practices and return the repaired instrument to the customer as the quality product the original design provided.

WARNING

This Instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument that is used carelessly. Therefore, the following notes must be read carefully and completely, before making any measurements or adjustments. Failure to follow directions can result in a serious or fatal accident.

SHOCK HAZARD: As defined in American National Standard, C39.5, Safety Requirements for Electrical and Electronic Measuring and Controlling Instrumentation, a shock hazard shall be considered to exist at any part involving a potential in excess of 30 volts rms (sine wave) or 42.4 volts DC or peak and where a leakage current from that part to ground exceeds 0.5 milliampere, when measured with an appropriate measuring instrument defined in Section 11.6.1 of ANSI C30.5-1974.

NOTE: The proper measuring instrument for the measurement of leakage current consists essentially of a network of a 1500 ohm non-inductive resistor shunted by a 0.15 microfarad capacitor connected between the terminals of the measuring instrument. The leakage current is that portion of the current that flows through the resistor. The Simpson Model 229 Series-2 AC Leakage Current Tester meets the ANSI C39.5 requirements for the measurement of AC leakage current and can be used for this purpose. To measure DC leakage current, connect a 1500 ohm non-inductive resistor in series with a Simpson 0-500 DC microammeter and use this as the measuring instrument.

Refer to GENERAL SAFETY PRECAUTIONS on next page.

PART ONE

GENERAL INFORMATION AND SPECIFICATIONS

SCOPE

This manual contains recommended repair and maintenance information for the Simpson Model 474 DMM. Repair should be performed only by authorized Simpson Service Centers having the proper equipment to perform the calibration procedure and subsequent performance tests listed herein. The service technician should thoroughly understand all functions of the Model 474 and the theory of operation before attempting any procedure in this manual.

INTRODUCTORY DESCRIPTION

The Simpson Model 474 Digital Multimeter (hereafter referred to as the Model 474, 474, or simply the Instrument) is a hand-held 4½ digit compact instrument weighing 1 pound, and measuring 1.8 x 3.4 x 7.1 inches (HWD). It features .03% DC voltage accuracy, single 9V battery operation and will measure a maximum of 1KV DC or 750V AC. Additional features include automatic polarity, automatic zeroing, 10MΩ input impedance, continuity detection with audible and visual indication, and protection against voltage transients of up to 6KV for 100μSec on all voltage and resistance ranges.

TECHNICAL SPECIFICATIONS

The following electrical specifications are valid for an operating temperature of +18°C to +28°C at relative humidity up to 90% unless otherwise noted.

I. DC VOLTAGE:

RANGE	MAXIMUM INDICATION	INPUT RESISTANCE	OVERLOAD PROTECTED TO
200mV	±199.99mV	10M Ω	±250 V (DC + Peak AC)
2 V	±1.9999 V	10M Ω	±1000V (DC + Peak AC)
20 V	±19.999 V	10M Ω	±1000V (DC + Peak AC)
200 V	±199.99 V	10M Ω	±1000V (DC + Peak AC)
1000 V	±1000.0 V	10M Ω	±1000V (DC + Peak AC)

ACCURACY: ± (0.03% + 2 counts) up to 200mV; ± (0.07% + 1 count) up to 1000V

SENSITIVITY: 10μV (200mV range)

FULL RANGE STEP RESPONSE: 1 second
(To Rated Accuracy)

NORMAL MODE REJECTION: 50dB minimum at 50/60Hz

COMMON MODE REJECTION: 120dB minimum at DC; 100dB minimum at 50/60Hz

II. AC VOLTAGE:

(Average-Sensing, rms Calibrated Sine Wave)

RANGE	MAXIMUM INDICATION	INPUT RESISTANCE	OVERLOAD PROTECTED TO
200mV	199.99mV	10MΩ and 100pf	±250 V (DC + Peak AC)
2 V	1.9999V	10MΩ and 100pf	±1000V (DC + Peak AC)
20 V	19.999 V	10MΩ and 100pf	±1000V (DC + Peak AC)
200 V	199.99 V	10MΩ and 100pf	±1000V (DC + Peak AC)
750 V	750.0 V	10MΩ and 100pf	±1000V (DC + Peak AC)

ACCURACY: 45 - 500Hz 45Hz - 1kHz

Except 2V: ±(1.0% + 5 counts) ±(1.0% + 10 counts)

2V Range: ±(1% + 5 counts) ±(3% + 10 counts)

Accuracy spec applicable to greater than 5% of full range.

FULL RANGE STEP RESPONSE: 3 seconds

(To Rated Accuracy)

III. RESISTANCE:

RANGE	MAXIMUM INDICATION	PROTECTED TO
200 Ω	199.99Ω	250V RMS
2KΩ	1.9999KΩ	250V RMS
20KΩ	19.999KΩ	250V RMS
200KΩ	199.99KΩ	250V RMS
20MΩ	19.999MΩ	250V RMS

ACCURACY: ± (0.2% of input + 2 counts), except on the 20MΩ and 200Ω ranges which are ± (0.4% of input + 2 counts) and ± (0.2% + 10 counts) respectively.

FULL RANGE STEP RESPONSE: 1 second, except on 20MΩ range which is 12 seconds at 10 Megohms (to rated accuracy).

DIODE TEST: Diode symbol indicated on 2KΩ range. Measures forward resistance of a semiconductor junction, at approximately 1.0ma.

CONTINUITY: (On 2KΩ Range) ≅200 ohms or less activates audible tone and display annunciator. Response time is essentially instantaneous.

OPEN CIRCUIT VOLTAGES: <3.5V all ranges.

IV. DC CURRENT:

RANGE	MAXIMUM INDICATION	BURDEN VOLTAGE	OVERLOAD PROTECTED TO
2mA	±1.9999mA	.25V Max.	2A (Fuse)*
20ma	±19.999mA	.25V Max.	2A (Fuse)*
200mA	±199.99mA	.25V Max.	2A (Fuse)*
2000mA	±1999.9mA	.9V Max.	2A (Fuse)*
10 A**	±10.000 A	.3V Max.	(None)

ACCURACY: ±(1.0% of input + 1 count) except on 2000mA and 10A ranges which are ±(2% of input + 1 count)

FULL RANGE STEP RESPONSE: 1 second

* High Energy Fuse
** Separate Jack

V. AC CURRENT:

RANGE	MAXIMUM INDICATION	BURDEN VOLTAGE	OVERLOAD PROTECTED TO
2mA	1.9999mA	.25V Max.	2A (Fuse)*
20mA	19.999mA	.25V Max.	2A (Fuse)*
200mA	199.99mA	.25V Max.	2A (Fuse)*
2000mA	1999.9ma	.9V Max.	2A (Fuse)*
10 A**	10.000A	.3V Max.	(None)

ACCURACY: ±(2% of input + 5 counts), except on 2000mA and 10A ranges which are ±(3% of input + 5 counts), from 45Hz to 1kHz.

Applicable to greater than 5% of full range.

FULL RANGE STEP RESPONSE: 3 seconds

* High Energy Fuse
** Separate Jack

VI. RATED CIRCUIT-TO-GROUND VOLTAGE: 1000V (DC + Peak AC) between any input terminal and power line (earth) ground.

VII. DISPLAY:

NUMERICAL DISPLAY: 4½ digit; 7-segment, Liquid Crystal Display (LCD) type with "Low Battery" indication (on at approximately 20 hours of remaining battery life) and continuity indication.

CONVERSION RATE: 1.5 readings per second minimum at 50/60Hz.

DC POLARITY SELECTION: Automatic, "-" sign indicated, "+" sign implied.

OVERRANGE INDICATION:

(Input greater than maximum indication) Most significant digit "on", all other digits off.

VIII. TRANSIENT PROTECTION:

(All voltage and resistance ranges) 6KV for 100μ sec. max.

IX. POWER REQUIREMENT: One 9-volt "transistor" battery

BATTERY TYPE: Alkaline: NEDA 1604A
Carbon Zinc: NEDA 1604

BATTERY LIFE: Alkaline: 200 Hrs. (nominal)

(Voltage and current ranges)

X. TEMPERATURE RANGE:

Operating: 0°C to +55°C

Storage: -40°C to +70°C

TEMPERATURE COEFFICIENT (from +0°C to +18°C and from +28°C to +55°C): Less than 0.1 times the accuracy of the function and range being used per °C.

XII. HUMIDITY RANGE:

+0°C to +35°C	90% Max. Non-condensing
+35°C to +55°C	70% Max. Non-condensing

XIII. SAFETY: Complies with the requirements of UL 1244.

XIV. FUSING: Both AC and DC current functions are protected (except 10 Amp Range) up to 2 amps with two fuses, F1 and F2.

XV. DIMENSIONS:

Height: 1.8" (4.57 cm)

Width: 3.4" (8.64 cm)

Length: 7.1" (18.03 cm)

XVI: WEIGHT: Approximately 1 lb.

PART TWO

INSTALLATION

GENERAL

There are no specific instructions for installing the Model 474. Operate, test and calibrate the instrument in a clean, dry environment that has relatively constant temperature and humidity levels.

OPERATING POSITION

As well as being hand-held operated, the Instrument may also be operated horizontally (on its back), at an inclined angle with the bail extended, or in a hanging position with bail repositioned, as shown in Figure 2-1.

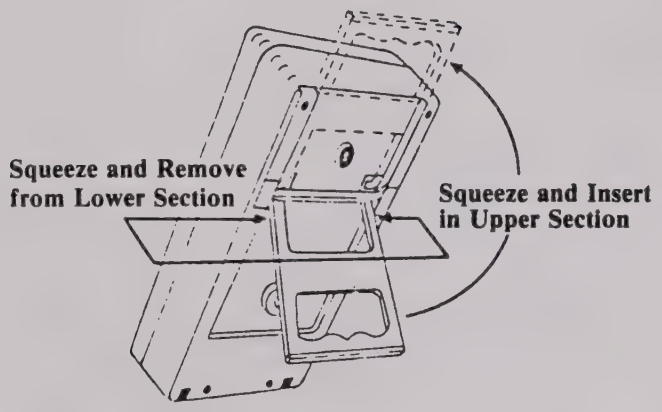


Figure 2-1. Bail Repositioning

POWER REQUIREMENTS

The Model 474 operates from a standard 9-volt "transistor" battery such as the (NEDA 1604A) alkaline, or (NEDA 1604) carbon-zinc type. The instrument will provide 200 hours of continuous operation with the alkaline battery, or 100 to 150 hours with the carbon-zinc. The 474 will automatically detect and display "B" (upper left-hand corner of display) when the battery voltage is below 7.0 volts approximately. The first appearance of the "B" signifies a remaining battery life of approximately 20 hours. A weak battery should be replaced at once in order to avoid possible instrument damage due to battery leakage.

BATTERY INSTALLATION/REPLACEMENT

Do not attempt to replace the battery in this or any instrument while it is in use.

1. Slide the power switch to the OFF position, and remove all leads from the Model 474.

2. Unscrew the battery compartment retaining screw, and slide the compartment door off (Figure 4-1).
3. Remove the old battery, IF ANY, and unclip it from the instrument.
4. Clip a new battery, (NEDA 1604A) into the 474 battery clip and check the terminals for a snug fit.
5. Carefully place the new battery in the battery compartment and refit the compartment door being sure to tighten the retaining screw.

FURTHER OPERATING INSTRUCTIONS

For further operating instructions, see the Model 474 Operator's Manual, Part No. 06-113168.

PART FOUR

MAINTENANCE

GENERAL

Familiarity with the operating procedures, performance specifications, theory of operation and physical makeup of this instrument is a prerequisite to attempting any procedure in Part Four of this bulletin.

DO NOT USE SUBSTITUTE PARTS.

All component types and values utilized in the Model 474 have been carefully selected. Should replacement be necessary, install the exact components specified in Part Five of this service bulletin to maintain the stability and accuracy of the instrument.

CAUTION

STATIC SENSITIVE COMPONENTS USED IN THIS INSTRUMENT.

As with the vast majority of modern digital equipment, the Model 474 utilizes low current, high speed C-MOS circuitry. C-MOS devices are particulary vulnerable to electrostatic discharge, (ESD) and can be inadvertently destroyed during replacement if proper equipment and procedures are not utilized. Static discharge can also cause latent degradation in components not detectable at the time of installation and subsequent testing. Parts weakened by ESD may later end up causing failures in the field.

Safe replacement of C-MOS devices requires application of grounded antistatic mats on the floor and workbench, as well as static discharge wrist straps and a low wattage "grounded" soldering iron.

See Table 3-2 for recommended types.

DISASSEMBLY PROCEDURE

The Disassembly Procedure is given in five parts with the separation of the front and rear case housings first. Removal of the A to D Converter/Display Board is then detailed along with replacement of the liquid crystal display. Finally, removal of the main PC board is detailed along with replacement of the piezo continuity transducer.

BASIC DISASSEMBLY (See Figures 3-1 and 3-2)

1. Set the power switch to the OFF position and remove all leads from the instrument.

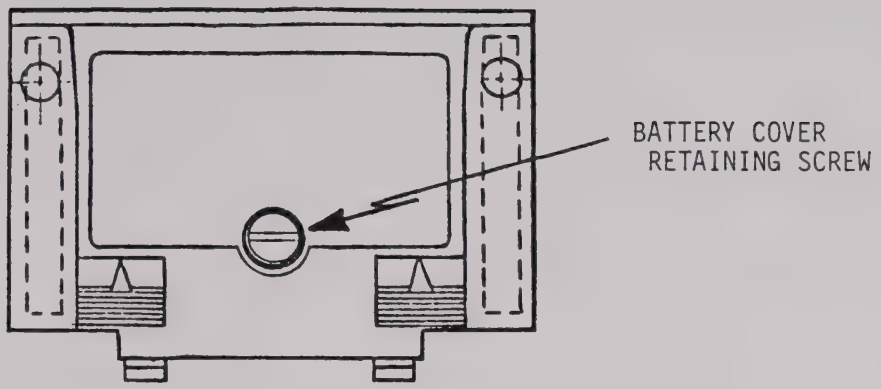


Figure 3-1. Battery Compartment Cover

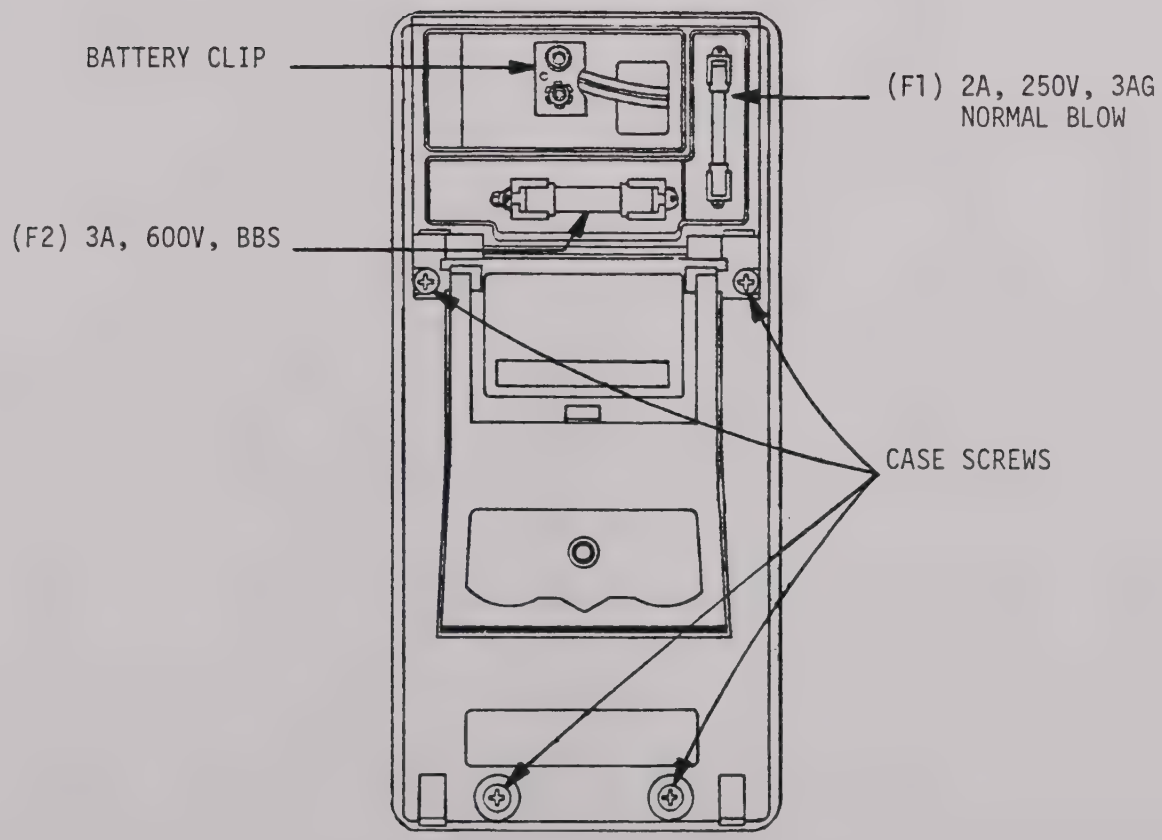


Figure 3-2. Rear Case Housing

DISASSEMBLY PROCEDURE (CONT.)

2. Place the 474 face down on a padded surface and unscrew the captivated battery compartment retaining screw. Slide the compartment door off and remove the 9V battery from the instrument.

3. Remove the four cabinet screws from the rear case housing, and carefully separate the front and rear portions of the case. Push the battery connector through the rectangular access hole inside the battery compartment.

   Note that the two case screws nearest the battery compartment extend through the main PC board, the PC shield insulator board, and the flexible PC shield.

DISPLAY BOARD REMOVAL (See Figure 3-3)

1. Locate and remove the three display board mounting screws.

2. Set the power switch to the ON position and carefully fold the board away from the front case.

CAUTION

Avoid excessive stress to the ribbon cables connecting the display board to the main PC board.

LCD REPLACEMENT (See Figures 3-3, 3-4 and 3-5)

Table 3-1. Parts Required for LCD Replacement

PART DESCRIPTION	PART NUMBER
L.C.D.	6-113146
Bezel	3-261083
Elastomer (white)	6-113429

All signal connections between IC104 and the liquid crystal display are made by a single elastomer "zebra" strip, with a second strip used for display positioning. Due to compression of the elastomer material over time, it is necessary to replace the conducting strip along with the LCD to avoid future display failures due to poor contact. This entire assembly is held in place with a plastic bezel which is heat staked to the display board and must also be replaced during reassembly.

1. With the display board separated from the case front, locate the four plastic staking pins which extend through the board from the bezel side.

2. Melt away the flair in the plastic pins with a low wattage soldering iron such that the pins can be pushed through the board.

3. Select a pointed instrument, such as a solder aid tool, and use it to carefully push the staking pins out of the PC board.

4. Clean the contact strips, and between the IC pins on the LCD side of the display board with a toothbrush and isopropyl alcohol prior to installation of the replacement display. Also clean the contact area on the LCD itself.

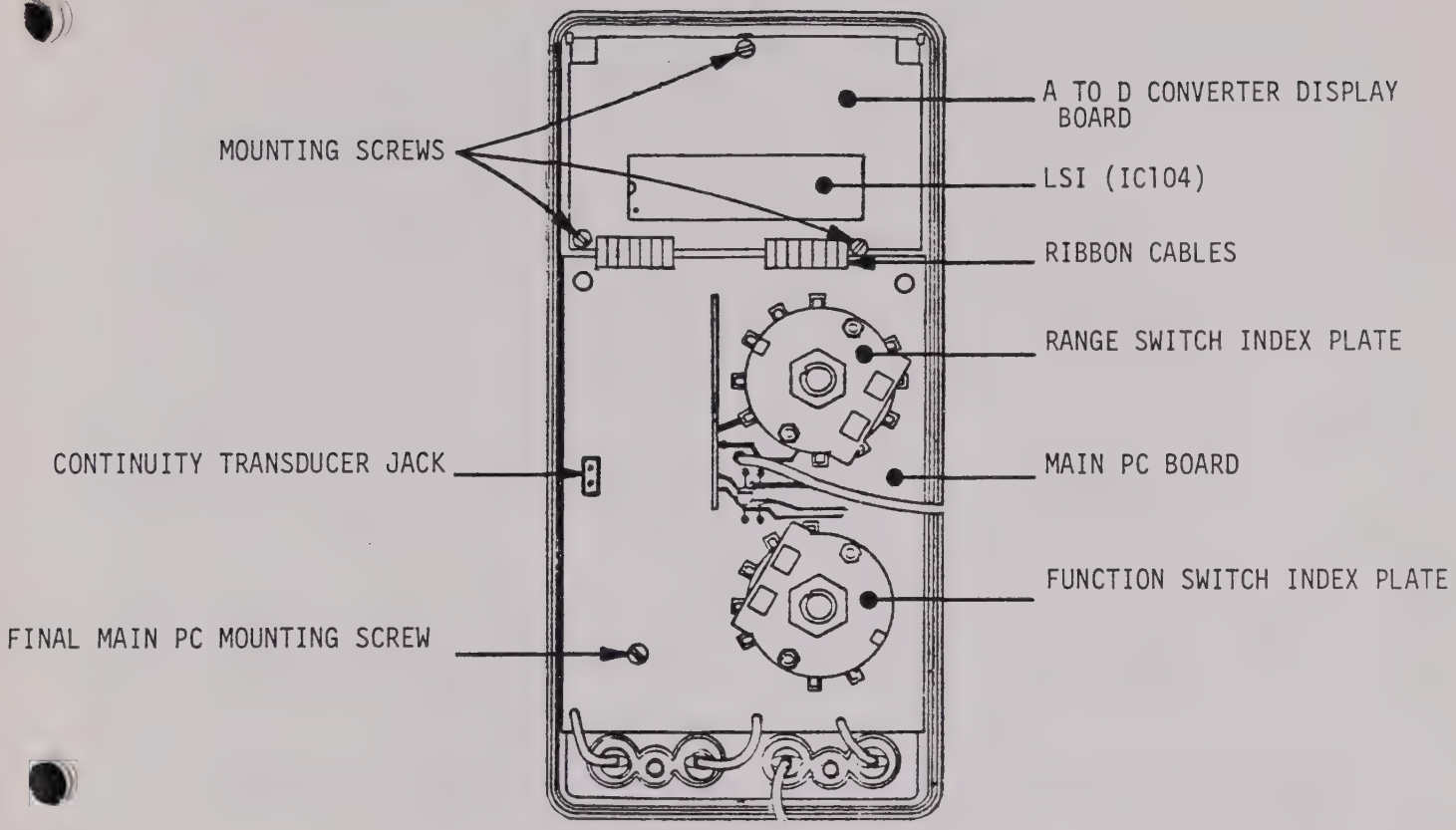


Figure 3-3. Front Case Assembly

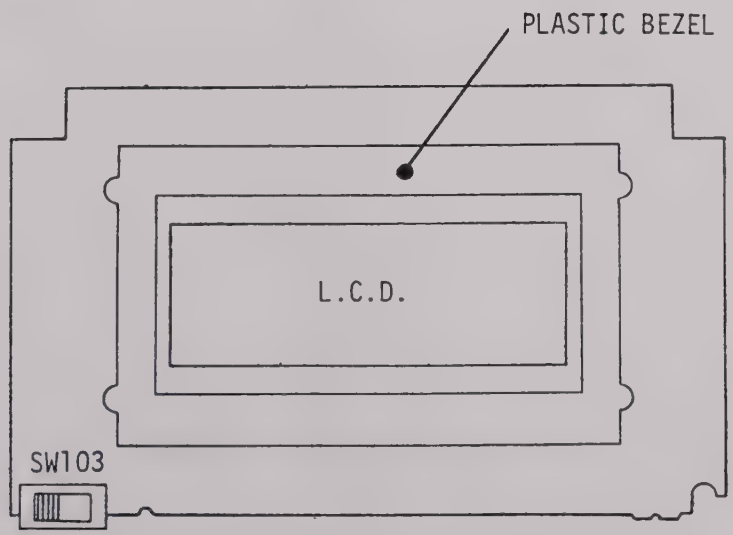


Figure 3-4. L.C.D. Bezel

NOTE

[1]Do not touch the contact areas on the board or the LCD with your fingers during the following procedure.

[2]Inspect the LCD for irregularities in the viewing area prior to display installation.

5. Set the replacement bezel on the edge of your workbench, and place the new LCD in the bezel with the contact edge toward you as shown in Figure 3-5A.

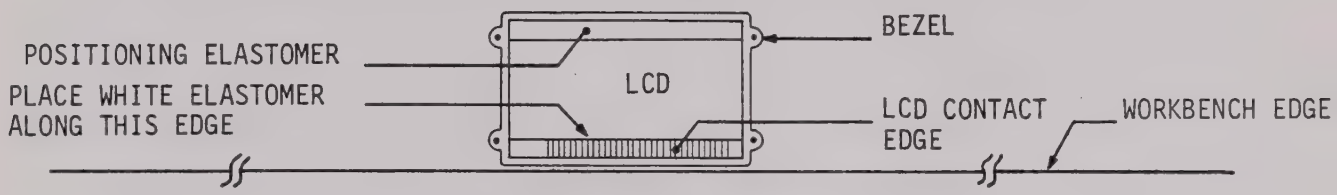


Figure 3-5A. LCD/Bezel Orientation

6. Insert the white replacement elastomer along the contact edge of the LCD, and the remaining elastomer, (blue or reddish-brown) along the top edge of the LCD. (See Figure 3-5A)

7. Place the rear case housing of the 474 on the workbench to the right of the replacement LCD assembly, while holding the front case assembly perpendicular to the workbench.

8. Position the display PC board over, and parallel to the replacement LCD assembly as shown in Figure 3-5B.

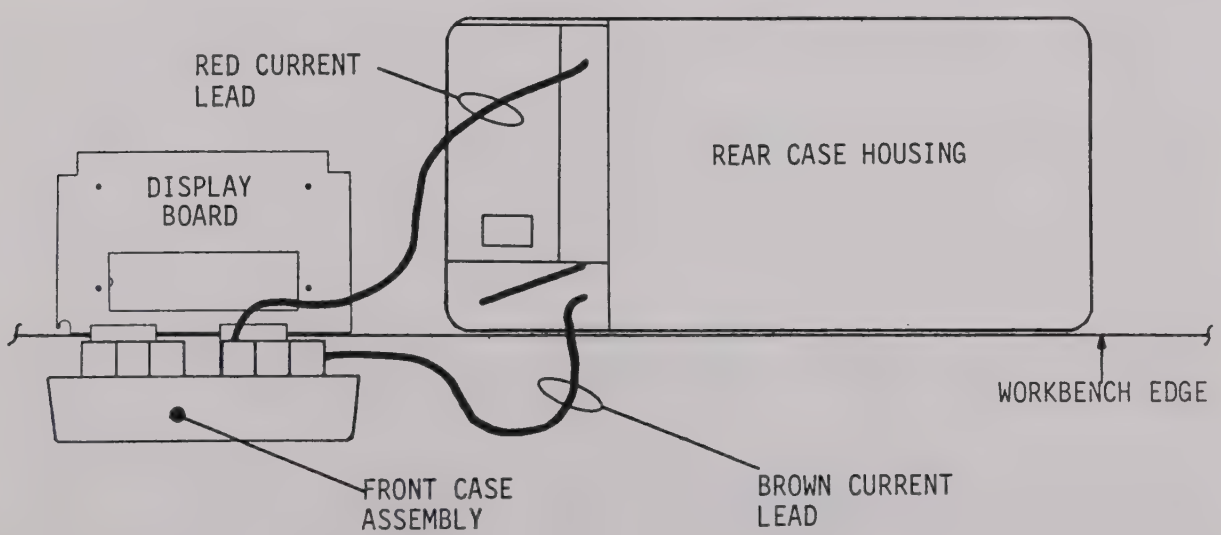


Figure 3-5B. Installation of LCD Assembly

9. Align the bezel staking pins with the holes in the display board, and press the board downward until the bezel is flush with the contact side of the PC board.

10. Fix the LCD assembly in place by melting a flair into each staking pin with a soldering iron.

Remount the display board by reversal of Steps 1 and 2 of the display board removal procedure, and proceed to the calibration instructions.

NOTE

Crystal X101 must remain in its original orientation with respect to the PC board.

MAIN PC BOARD REMOVAL (See Figure 3-3)

1. Perform the basic disassembly and display board removal procedures.

2. Untape the flexible PC board shield from the transducer plug, and fold the shield out of the way.

3. Remove the final main PC board mounting screw located next to R102, and unplug the continuity transducer.

NOTE

Make sure that all PC board mounting screws, including those securing the A to D converter/ display board, are removed BEFORE attempting to remove the main PC board. Avoid any unnecessary strain to the ribbon cables that connect the A to D converter/display board to the main PC board.

4. With the Model 474 face down on your padded working surface, grasp the metal index plate of the range switch between the thumb and index finger of your right hand. Grasp the function switch index plate in the same manner with your left hand. Hold the instrument in place by bracing your remaining fingers on the upturned edge of the top case housing.

5. Pull the range and function switches toward you while alternating pressure, in a rocking motion, with your hands. This will pull the switch shafts out of the range and function knobs freeing the PC board.

NOTE

It is not recommended nor desirable that any type of pry lever be used to remove the main PC board.

6. Using the input jack connection wires as a hinge point, rotate the PC boards away from the top case housing.

CAUTION

The PC shield and insulator are held in place by a single screw and nut. The shield foil can be easily broken if the mounting screw is carelessly removed or over-tightened during reassembly. An inoperative PC shield will result in noise pick-up and unstable readings on AC functions.

7. Carefully remove the PC shield mounting screw, and separate the shield, insulator/spacer board, and the main PC board.

   The PC boards may now be placed in a convenient position for servicing.

   Should the piezo transducer prove defective, it is removed from the instrument after removing the spring retainers from the three binding posts around it. Separate the defective transducer from the transducer housing.

REASSEMBLY INSTRUCTIONS

1. Perform a functional test on the instrument before reassembly, to assure proper operation.

2. Rotate the range and function switches fully clockwise as viewed from the foil side of the PC board.

3. Turn the range and function knobs in the top case housing to the 200Ω position.

4. Refit the insulator/spacer board and PC shield positioning the nylon spacers against the main PC board.

5. Carefully install and retighten the shield assembly screw and nut. Check for continuity between the assembly screw and analog ground.

NOTE

Push on the switch index assemblies, NOT the PC board during Step 6.

6. Carefully align the range and function knobs with their respective switch shafts and gently push the switch shafts into their knobs.

From this point on, reassemble the instrument by reversal of the appropriate procedures.

Do not overtighten the final main PC mounting screw, and be careful that no leads are crimped between any surfaces during reassembly. Dress the red and brown current leads into the groves along the outside edges in the bottom of the rear case housing.

CAUTION

If it becomes necessary to unsolder any of the leads from the input jacks, insert a reverse banana plug into the jack before application of heat to avoid distorting the case.

CALIBRATION

To provide the most accurate calibration under normal operating conditions, the Model 474 should be calibrated at an ambient temperature of 25°C ± 5°, and a relative humidity of 20-60%. Neither the Model 474 nor the calibration test equipment should be subjected to strong sources of interference such as AC or RF fields during this procedure. Allow an adequate warmup period for all equipment used during calibration. If the 474 is fully assembled, remove the rear case housing as per the basic disassembly procedure, and locate the calibration potentiometers, (R122, R143 and R146), from Figure 3-13. If the instrument is fully disassembled after being serviced, reinstall the PC boards and all hardware, less the back cover housing, and perform a functional test prior to calibration.

EQUIPMENT REQUIRED FOR CALIBRATION

The test equipment listed in Table 3-2 is required to calibrate and subsequently test all ranges and functions of the Model 474 Digital Multimeter. The specifications listed are the minimum values necessary to ensure accurate calibration.

Table 3-2. Equipment Required for Calibration

ITEM	ACCURACY	RECOMMENDED MODEL
DC Voltage Standard	0-900V at .003%	Rotek Model 610
AC Voltage Standard	0-750V, 500Hz/1KHz at .1%	Rotek Model 610
DC Current Standard	0-1 Amp at .1%	Rotek Model 610
AC Current Standard	0-1.7mA, 1KHz at .2%	Rotek Model 610
Decade Resistance Box	0-10MΩ at .02%	Rotek Model 610
Decade Resistance Box	130Ω and 600Ω at .1%	E.S.I. Dekabox - DB62
STATIC CONTROL WORK STATIONS		
Charleswater (or) Semtronics	M-CP625 EN-6304	(Both stations consist of a bench mat, floor mat, wrist strap and grounding wires)

CALIBRATION PROCEDURE

Calibration of the Model 474 is performed in two steps. First, the LCD contrast is adjusted, then the coarse and fine DC reference voltages are set.

LCD CONTRAST ADJUSTMENT

The Model 474 utilizes a triplexed liquid crystal display that is driven by AC signals riding on DC levels. These DC levels are made variable in the 474 to provide a contrast adjustment for the display segments. With the contrast adjustment, (R143), set correctly, the LCD will provide maximum contrast with a minimum of ghosting (display of extraneous segments).

1. Set the 474 on the 200Ω range, and adjust R143 fully clockwise (display off). Set the power switch to the ON position.

LCD CONTRAST ADJUSTMENT (CONT.)

2. Place the instrument such that the lower left corner of the display window is closest to you and at a 7 to 8 o'clock position as shown in Figure 3-6.

3. Tip the meter so the viewing angle is shallow, approximately 20° above the display surface, and observe the lower left quadrant of the display during the next step. (See Figure 3-6).

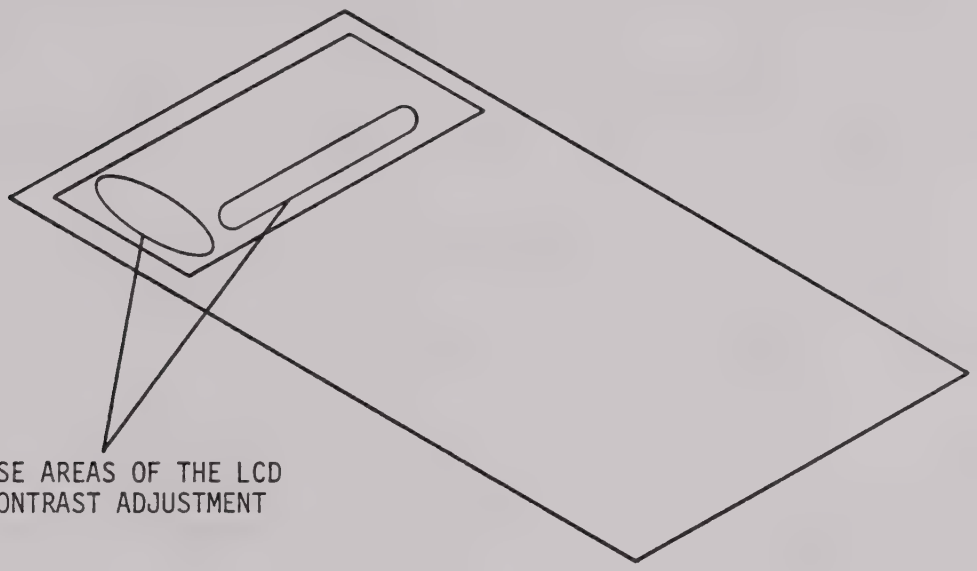


Figure 3-6. LCD Contrast Adjustment

4. Turn R143 slowly counterclockwise until the bottom row of segments and decimals just begin to appear and STOP at that point. The continuity symbol "C", and the low battery symbol "B" will also become visible at or slightly before this point.

5. Now view the display perpendicular to its surface and check that only the over-range "1" and decimal point can be seen, with no ghosting of extraneous segments.

DC REFERENCE ADJUSTMENT

Locate the DC calibration potentiometers, R122 and R146, from Figure 4-13. R122 is a coarse adjustment with R146 providing fine adjustment.

1. Set the 474 on the 200mV DC range, and set R146 to its midpoint.

2. Connect the 474 to the DC voltage standard and apply 100.00mV.

3. Adjust R122 for a reading of approximately 100.00mV.

DC REFERENCE ADJUSTMENT (CONT.)

4. Adjust R146 until the 474 indicates 100.00mV ±1 count.

This concludes the calibration procedure.

PERFORMANCE VERIFICATION TESTS

The following performance tests are used to assure the proper operation of the instrument on all ranges. A functional test of the continuity buzzer is included. The maximum deviation in counts should not be exceeded and any such deviation indicates the need for further repair or calibration.

VERIFICATION OF DECIMAL POINT POSITION

Table 3-3 shows the decimal point that will activate per a given function and range setting.

Table 3-3. Decimal Point Locations

RANGE	DECIMAL POINT LOCATION
200Ω	100.00
2KΩ	1.0000
20KΩ	10.000
200KΩ	100.00
20MΩ	10.000
*	1000.0

*Decimal location for all functions other than KΩ, on the highest range.

LOW BATTERY INDICATOR TEST

NOTE

The following test may be performed on any function except ohms.

1. Set the DC voltage standard to 6.25V and connect it to the battery clip of the 474. (The large contact on the clip is positive). With 6.25V DC applied, the low battery symbol "B" at the left hand side of the display must be ON.

2. Increase the output of the DC standard to 7.7V DC. The low battery symbol should now be OFF.

DC VOLTAGE TEST

Connect the 474 to the DC voltage standard, and perform the steps in Table 3-4.

Table 3-4. DC Voltage Test

STEP	RANGE	PARAMETER APPLIED	MAXIMUM DEVIATION IN COUNTS
1	200mV	Short	±2
2	200mV	±100.00mV	±5
3	200mV	+0.2500V	(overrange) All digits blank except MSD "1"
4	2V	Short	±1
5	2V	±1.7000V	±13
6	20V	±17.000V	±13
7	200V	±190.00V	±14
8	1000V	-900.0V	±7

The continuity buzzer shall not come on during this test.

AC VOLTAGE TEST

1. Set the 474 on the AC voltage function, and apply a short between the VΩ and COM jacks.

2. Switch through all ranges noting that the maximum deviation from zero is ±5 counts.

3. Connect the 474 to the AC voltage standard, and perform the steps in Table 3-5 .

Table 3-5. AC Voltage Test

STEP	RANGE	PARAMETER APPLIED	MAXIMUM DEVIATION IN COUNTS
FREQUENCY = 500Hz			
1	200mV	100.00mV	±105
2	2V	1.7000V	±175
FREQUENCY = 1kHz			
3	200mV	100.00mV	±110
4	2V	1.7000V	±520
5	20V	17.000V	±180
6	200V	170.00V	±180
7	750V	750.0V	±85

The continuity buzzer shall not come on during this test.

NOTE

Stability of the voltage source is critical to prevent bouncing on the low mV range.

DC CURRENT TEST

Connect the 474 to the DC current standard, and perform the steps in Table 3-6.

Table 3-6. DC Current Test

STEP	RANGE	PARAMETER APPLIED	MAXIMUM DEVIATION IN COUNTS
1	2mA	Short	±1
2	2mA	1.7000mA	±171
3	20mA	-17.000mA	±171
4	200mA	+170.0mA	±171
5	2000mA	1000.0mA	±201
*6	20mA/10A	1.000A	±21

*Apply the 1.000A input between the 10A and COM jacks.
The continuity buzzer shall not come on during this test.

AC CURRENT TEST

Connect the 474 to the AC current standard, and perform the steps in Table 3-7.

Table 3-6. AC Current Test

STEP	RANGE	PARAMETER APPLIED	MAXIMUM DEVIATION IN COUNTS
1	2mA	Short	±5
FREQUENCY = 1kHz			
2	2mA	1.7000mA	±345

The continuity buzzer shall not come on during this test.

RESISTANCE TEST

NOTE

When measuring low resistance values (200 ohm range):

[1]Determine and record the resistance value of the test leads being used.

[2]Connect the test leads to the resistance under test. Make sure the connections are electrically clean and mechanically secure.

[3]The value of the resistance under test is equal to the value indicated on the readout minus the lead resistance determined in Step (1) above.

Connect the 474 to the resistance decade box, and perform the steps in Table 3-8.

Table 3-8. Resistance Test

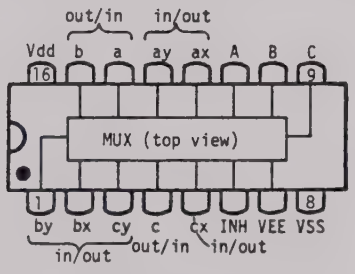
STEP	RANGE	PARAMETER APPLIED	MAXIMUM DEVIATION IN COUNTS	"C" SYMBOL AND BUZZER
1	200Ω	Short	±10	OFF
2	200Ω	100Ω	±30	OFF
3	2K	130Ω	*	ON
4	2K	600Ω	*	OFF
5	2K	1K	±22	OFF
6	20K	10K	±22	OFF
7	200K	100K	±22	OFF
8	20M	1M	±6	OFF
9	20M	10M	±42	OFF

*Steps 3 and 4 check the threshold of the continuity circuit.

This concludes the Range Accuracy Tests for the Model 474.

IC104
ICL7129

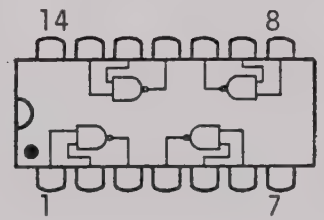
PIN #	FUNCTION	PIN #	FUNCTION	PIN #	FUNCTION	PIN #	FUNCTION
1	OSC 1	11	A3,G3,D3	21	DP3/UR	31	Buff
2	OSC 3	12	F3,E3,DP3	22	Latch/Hold	32	IN LO
3	Annunciator Drive	13	B4,C4,BC5	23	V-	33	IN HI
4	B1,C1,CONT	14	A4,D4,G4	24	V+	34	REF HI
5	A1,G1,D1	15	F4,E4,DP4	25	INT IN	35	REF LO
6	F1,E1,DP1	16	BP3	26	INT OUT	36	DGND
7	B2,C2,LO BATT	17	BP2	27	Continuity	37	Range
8	A2,G2,D2	18	BP1	28	Common	38	DP2
9	F2,E2,DP2	19	V Disp	29	Cref +	39	DP1
10	B3,C3,Minus	20	DP4/OR	30	Cref -	40	OSC 2



IC105, 106
4053

INPUT STATES				"ON" CHANNELS
Inhibit	C	B	A	4053
0	0	0	0	cx, bx, ax
0	0	0	1	cx, bx, ay
0	0	1	0	cx, by, ax
0	0	1	1	cx, by, ay
0	1	0	0	cy, bx, ax
0	1	0	1	cy, bx, ay
0	1	1	0	cy, by, ax
0	1	1	1	cy, by, ay
1	*	*	*	None

* Don't Care Condition



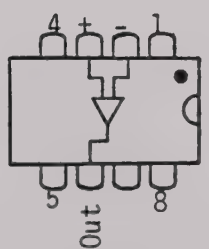
IC102
4093

BOTTOM VIEW

Q101,102,104,105,106,107
2N4123 (NPN)
Q103
MPS3702 (PNP)

BOTTOM VIEW

IC103
ICL8069CCZR



IC101
TL061

Figure 3-7. Component Pin Functions

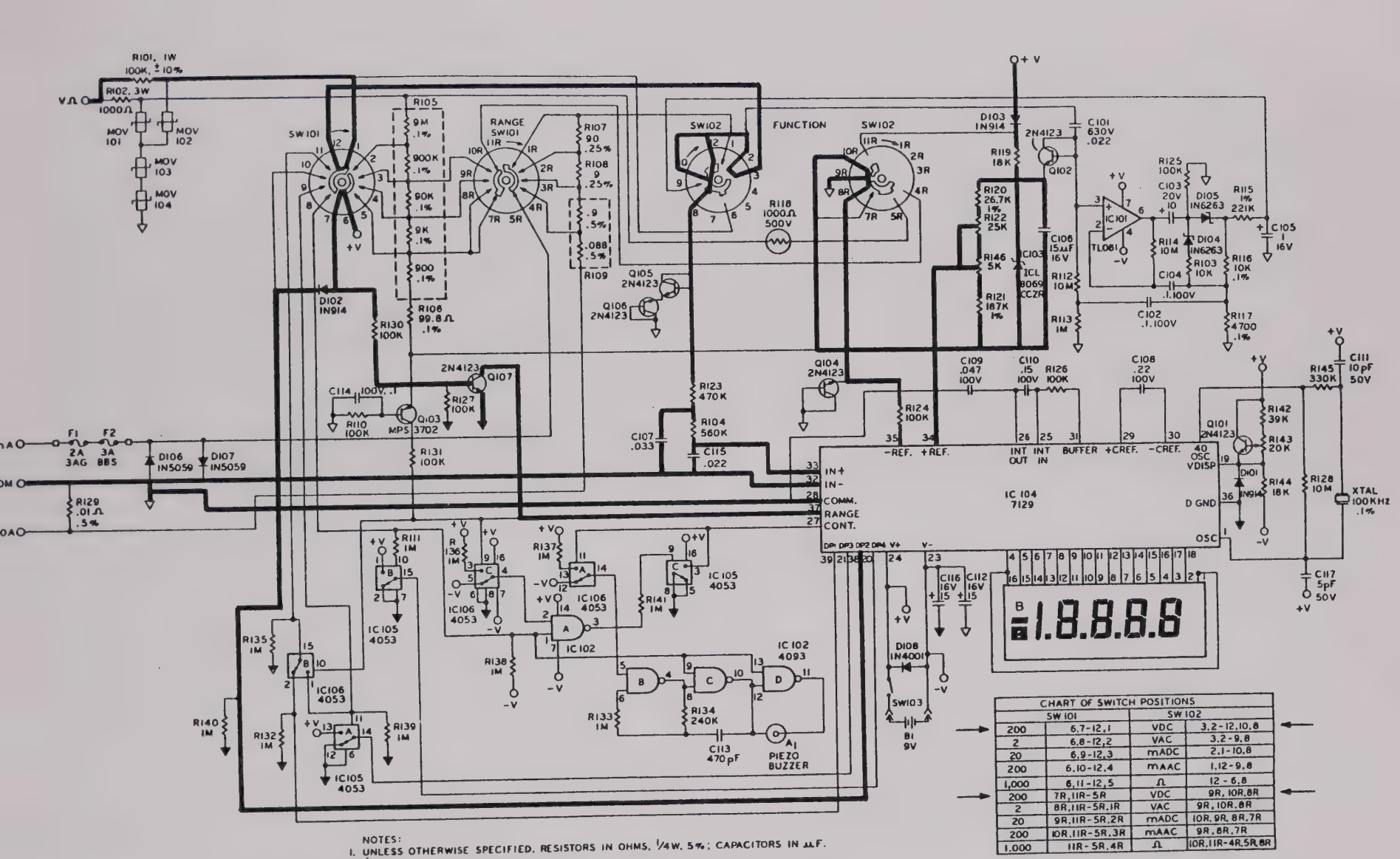


CHART OF SWITCH POSITIONS			
SW 101		SW 102	
200	6,7-12,1	VDC	3,2-12,10,8
2	6,8-12,2	VAC	3,2-9,8
20	6,9-12,3	mADC	2,1-10,8
200	6,10-12,4	mAAC	1,12-9,8
1,000	6,11-12,5	Ω	12-6,8
200	7R,11R-5R	VDC	9R,10R,8R
2	8R,11R-5R,1R	VAC	9R,10R,8R
20	9R,11R-5R,2R	mADC	10R,9R,8R,7R
200	10R,11R-5R,3R	mAAC	9R,8R,7R
1,000	11R-5R,4R	Ω	10R,11R-4R,5R,6R

NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTORS IN OHMS, 1/4W, 5%; CAPACITORS IN μF.
2. ⏚ DENOTES ANALOG GROUND
   ⏚ DENOTES DIGITAL GROUND
3. SWITCHES SHOWN IN FULLY CCW POSITION (200Ω)
4. D104 & D105 ARE A MATCHED PAIR.

Figure 3-8. 200mVDC Signal Path and Reference

Simpson
INSTRUMENTS THAT STAY ACCURATE
CUSTOMER SERVICE

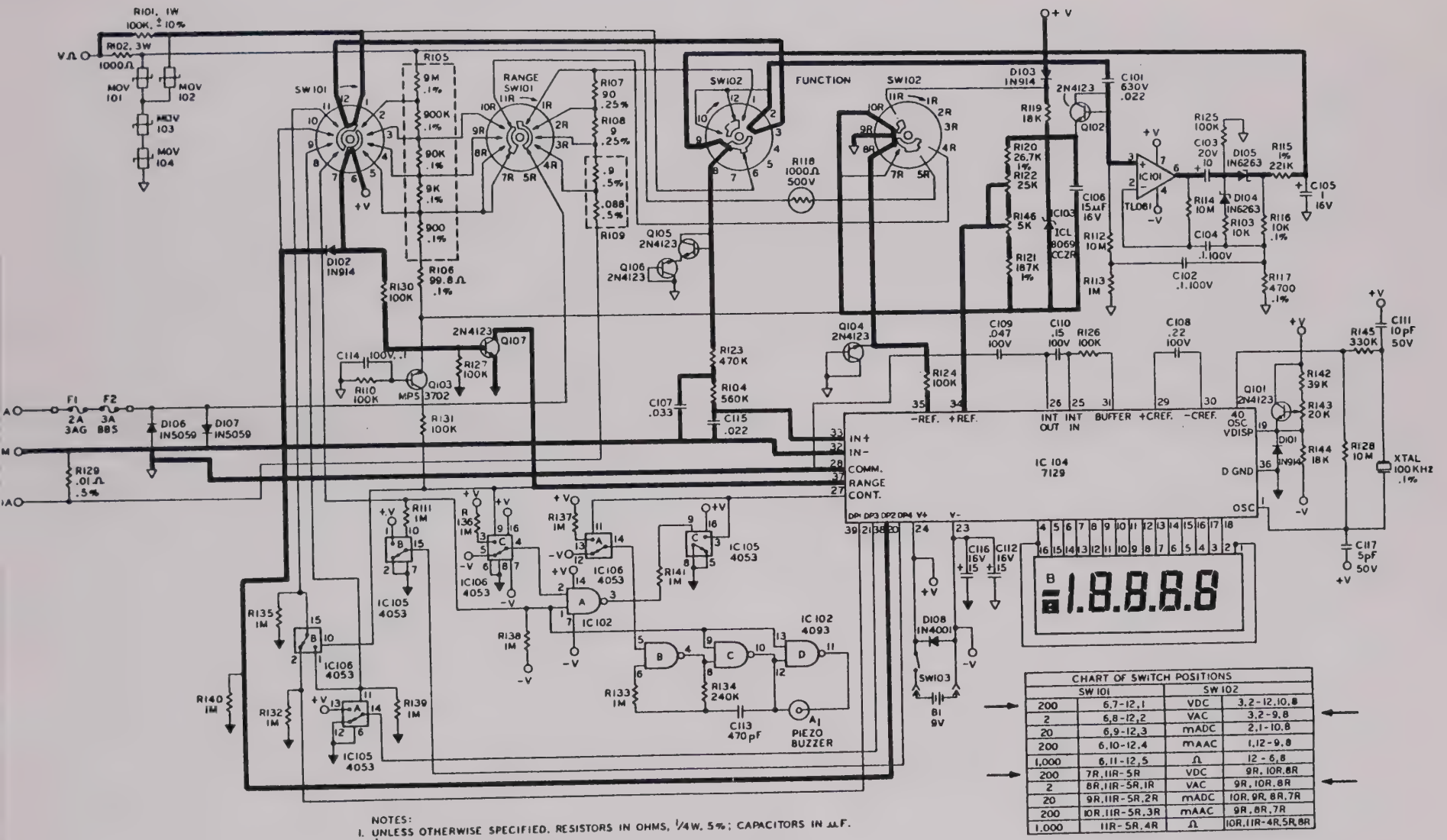


CHART OF SWITCH POSITIONS			
SW 101		SW 102	
200	6,7-12,1	VDC	3,2-12,10,8
2	6,8-12,2	VAC	3,2-9,8
20	6,9-12,3	mADC	2,1-10,8
200	6,10-12,4	mAAC	1,12-9,8
1,000	6,11-12,5	Ω	12-6,8
200	7R,11R-5R	VDC	9R,10R,8R
2	8R,11R-5R,1R	VAC	9R,10R,8R
20	9R,11R-5R,2R	mADC	10R,9R,8R,7R
200	10R,11R-5R,3R	mAAC	9R,8R,7R
1,000	11R-5R,4R	Ω	10R,11R-4R,5R,8R

NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTORS IN OHMS, 1/4W, 5%; CAPACITORS IN µF.
2. ⏚ DENOTES ANALOG GROUND
   ↓ DENOTES DIGITAL GROUND
3. SWITCHES SHOWN IN FULLY CCW POSITION (200Ω)
4. D104 & D105 ARE A MATCHED PAIR.

Figure 3-9. 200mVAC Signal Path and Reference

Simpson
INSTRUMENTS THAT STAY ACCURATE
CUSTOMER SERVICE

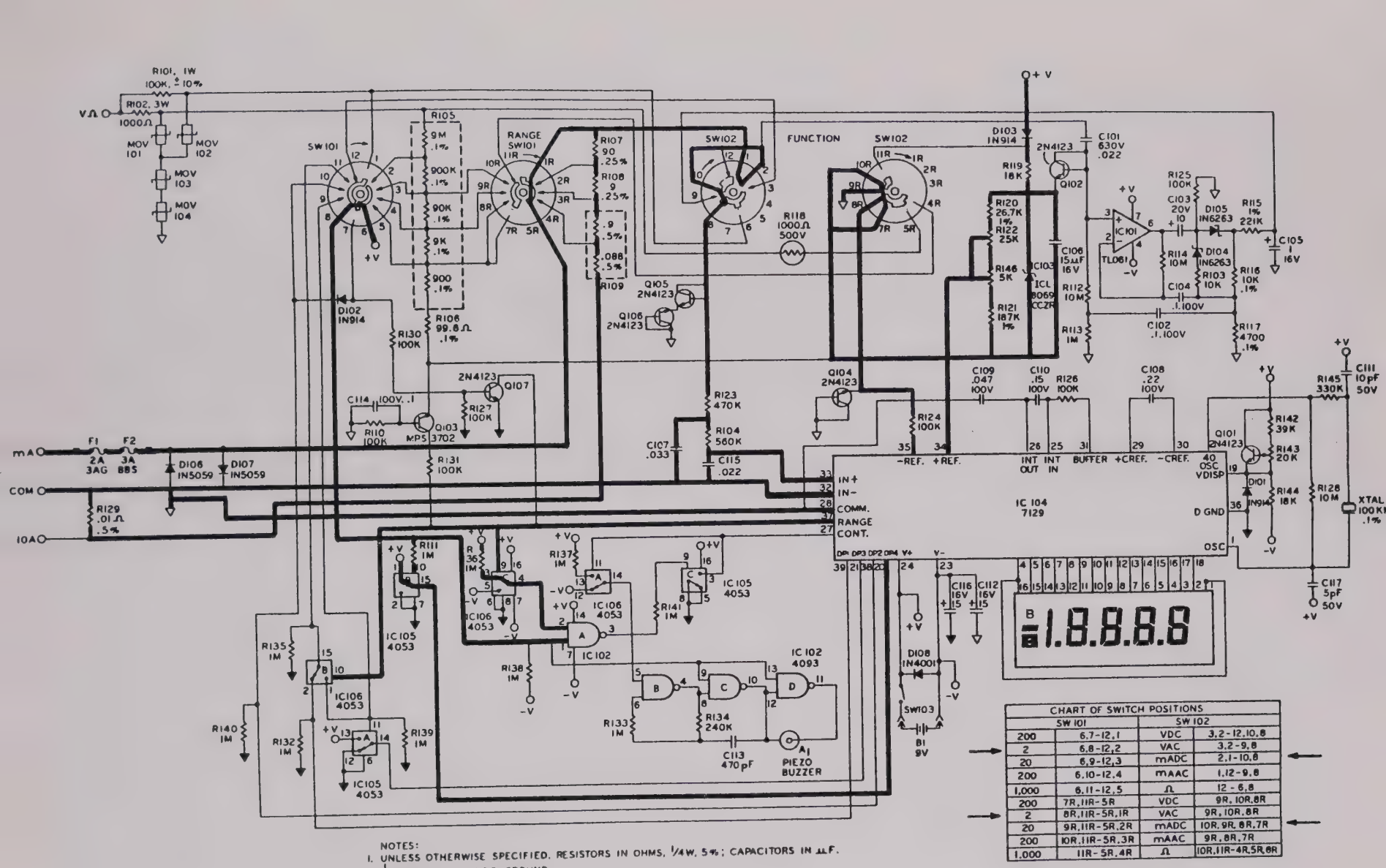


CHART OF SWITCH POSITIONS			
SW 101		SW 102	
200	6,7-12,1	VDC	3,2-12,10,8
2	6,8-12,2	VAC	3,2-9,8
20	6,9-12,3	mADC	2,1-10,8
200	6,10-12,4	mAAC	1,12-9,8
1,000	6,11-12,5	Ω	12-6,8
200	7R,11R-5R	VDC	9R,10R,8R
2	8R,11R-5R,1R	VAC	9R,10R,8R
20	9R,11R-5R,2R	mADC	10R,9R,8R,7R
200	10R,11R-5R,3R	mAAC	9R,8R,7R
1,000	11R-5R,4R	Ω	10R,11R-4R,5R,6R

NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTORS IN OHMS, 1/4W, 5%; CAPACITORS IN µF.
2. ⏚ DENOTES ANALOG GROUND
   ↓ DENOTES DIGITAL GROUND
3. SWITCHES SHOWN IN FULLY CCW POSITION (200Ω)
4. D104 & D105 ARE A MATCHED PAIR.

Figure 3-10. 2mA DC Signal Path and Reference

Simpson
INSTRUMENTS THAT STAY ACCURATE
CUSTOMER SERVICE

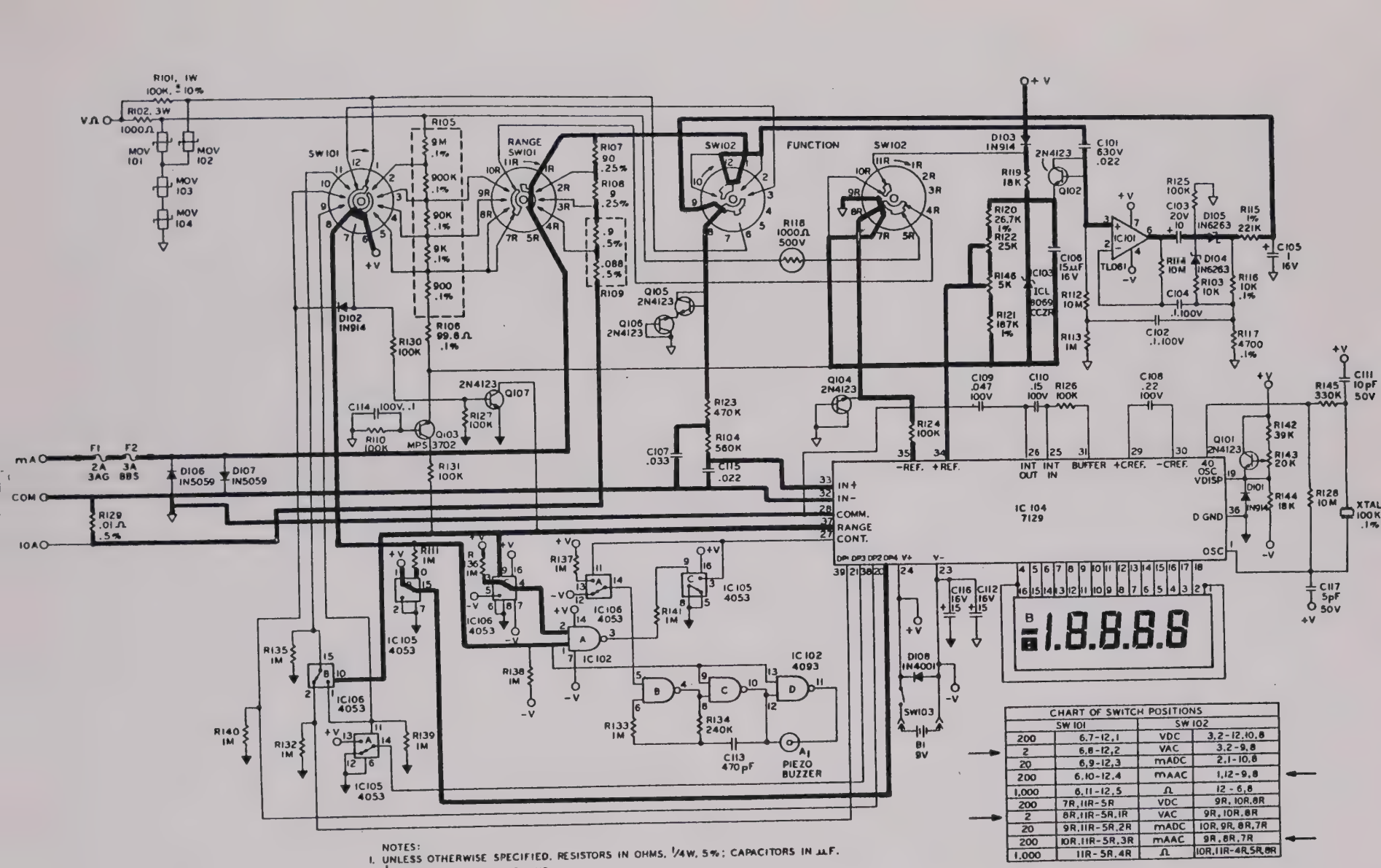
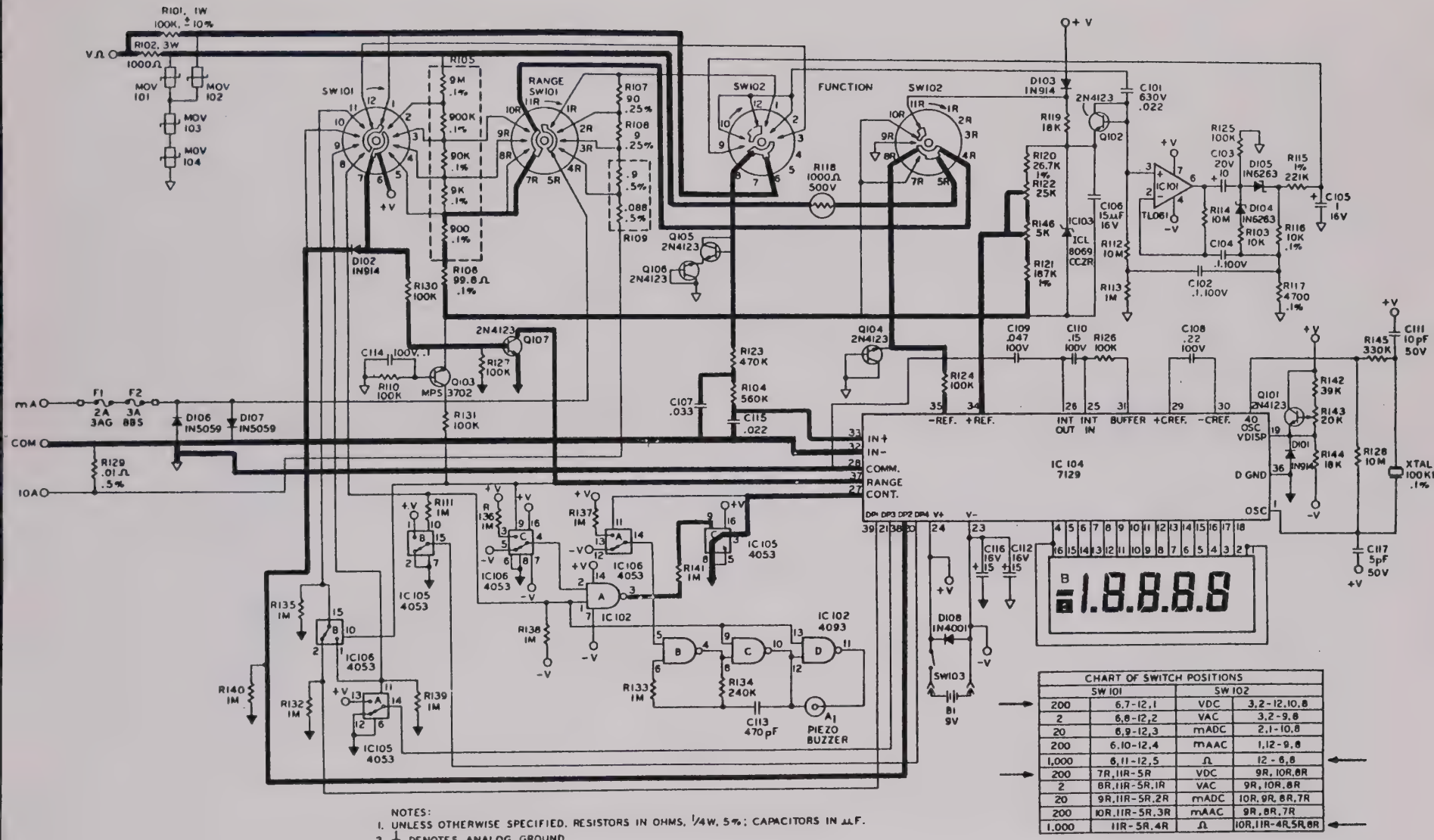


CHART OF SWITCH POSITIONS			
SW 101		SW 102	
200	6,7-12,1	VDC	3,2-12,10,8
2	6,8-12,2	VAC	3,2-9,8
20	6,9-12,3	mADC	2,1-10,8
200	6,10-12,4	mAAC	1,12-9,8
1,000	6,11-12,5	Ω	12-6,8
200	7R,11R-5R	VDC	9R,10R,8R
2	8R,11R-5R,1R	VAC	9R,10R,8R
20	9R,11R-5R,2R	mADC	10R,9R,8R,7R
200	10R,11R-5R,3R	mAAC	9R,8R,7R
1,000	11R-5R,4R	Ω	10R,11R-4R,5R,8R

NOTES:
1. UNLESS OTHERWISE SPECIFIED. RESISTORS IN OHMS. 1/4W, 5%; CAPACITORS IN µF.
2. ⏚ DENOTES ANALOG GROUND
   ↓ DENOTES DIGITAL GROUND
3. SWITCHES SHOWN IN FULLY CCW POSITION (200Ω)
4. D104 & D105 ARE A MATCHED PAIR.

Figure 3-11. 2mA AC Signal Path and Reference

Simpson
INSTRUMENTS THAT STAY ACCURATE
CUSTOMER SERVICE



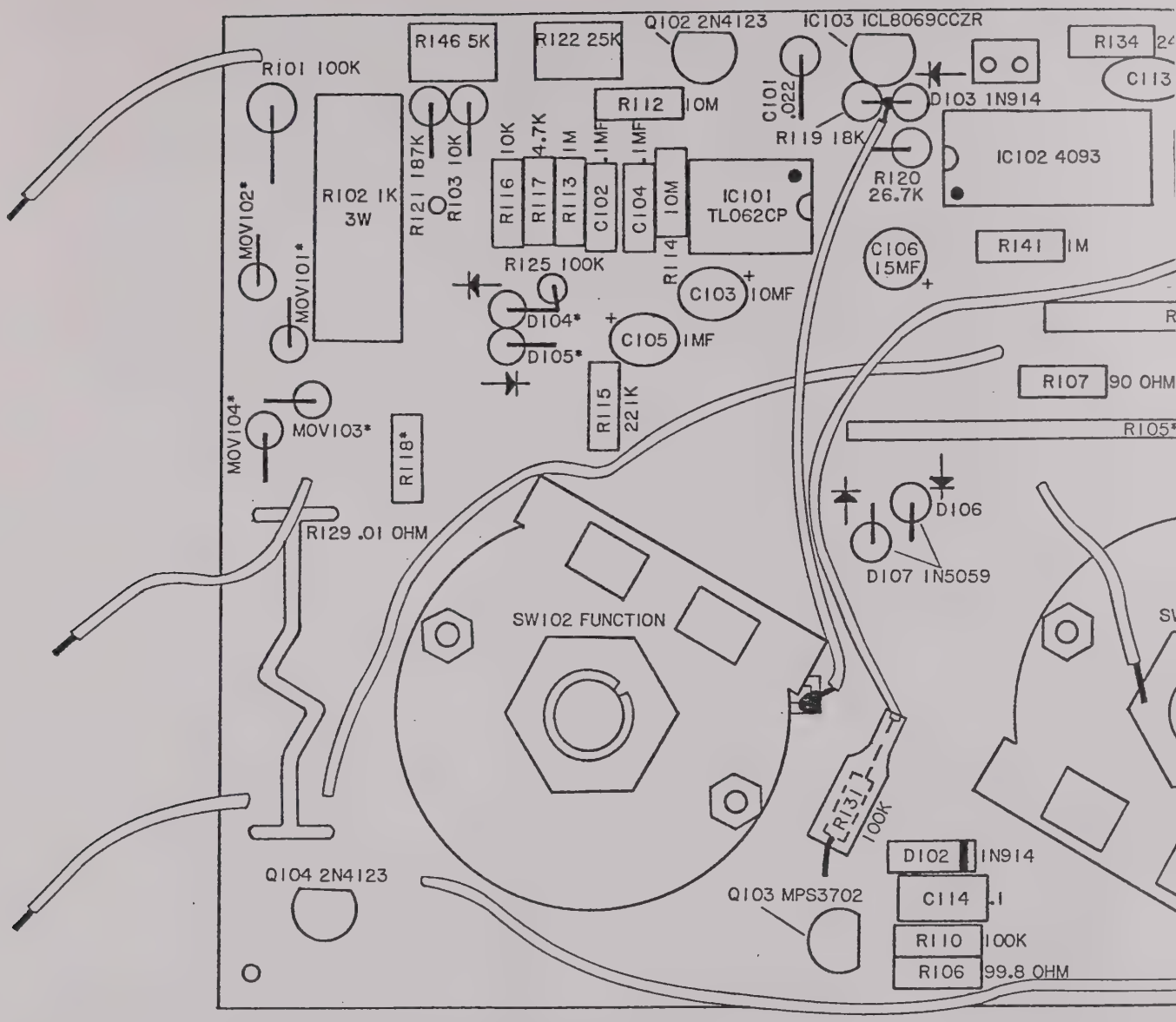
NOTES:
1. UNLESS OTHERWISE SPECIFIED. RESISTORS IN OHMS, 1/4W, 5%; CAPACITORS IN µF.
2. ⏚ DENOTES ANALOG GROUND
   ↓ DENOTES DIGITAL GROUND
3. SWITCHES SHOWN IN FULLY CCW POSITION (200Ω)
4. D104 & D105 ARE A MATCHED PAIR.

CHART OF SWITCH POSITIONS

	SW 101	SW 102	
200	6,7-12,1	VDC	3,2-12,10,8
2	6,8-12,2	VAC	3,2-9,8
20	6,9-12,3	mADC	2,1-10,8
200	6,10-12,4	mAAC	1,12-9,8
1,000	6,11-12,5	Ω	12-6,8
200	7R,11R-5R	VDC	9R, 10R,8R
2	8R,11R-5R,1R	VAC	9R, 10R,8R
20	9R,11R-5R,2R	mADC	10R,9R,8R,7R
200	10R,11R-5R,3R	mAAC	9R,8R,7R
1,000	11R-5R,4R	Ω	10R,11R-4R,5R,6R

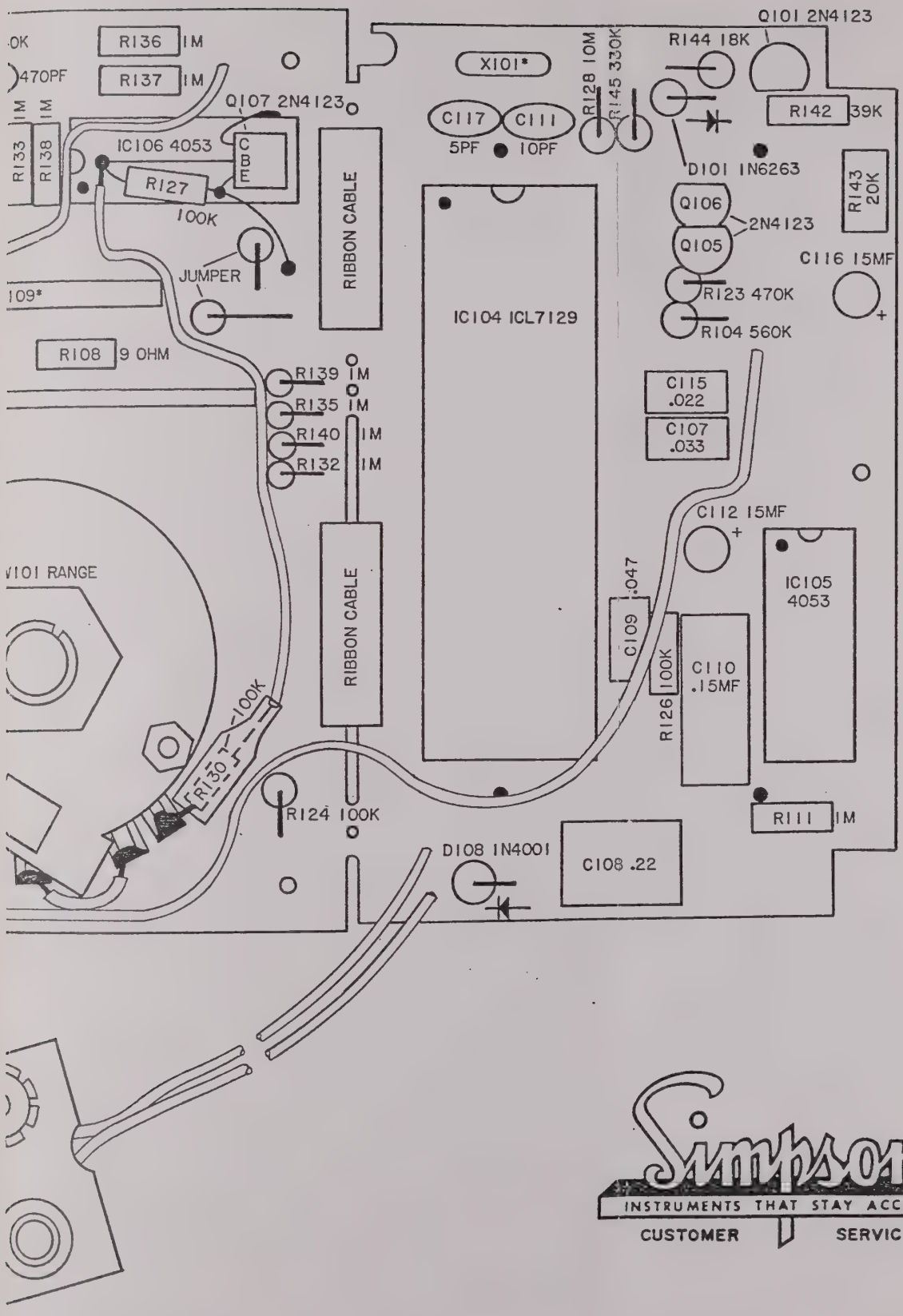
Figure 3-12. 200 Ohm Signal Path

Simpson
INSTRUMENTS THAT STAY ACCURATE
CUSTOMER SERVICE



* SEE PARTS LIST FOR COMPONENT TYPE.

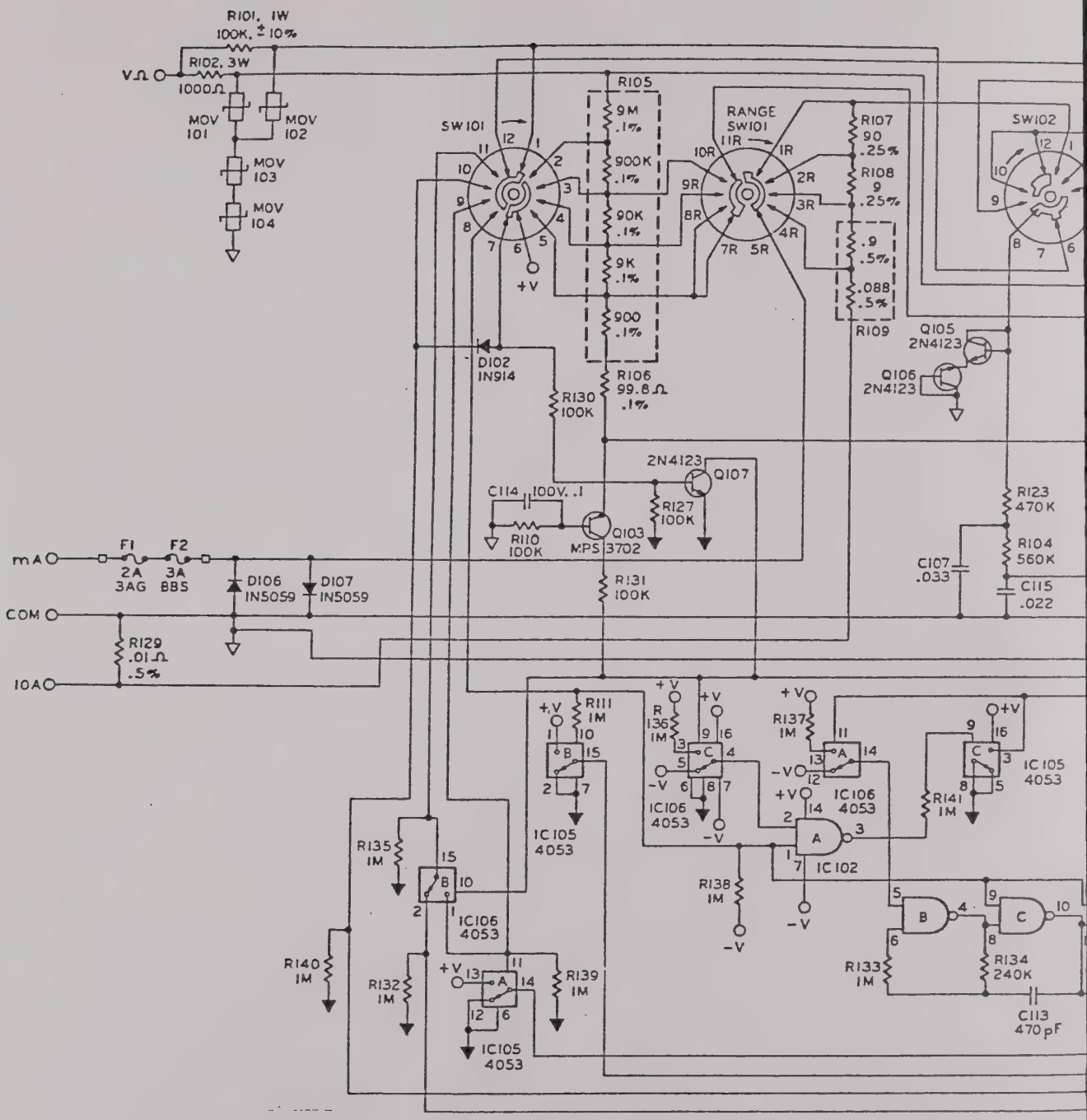
FIGURE 3-13. COMPONENT



Simpson

INSTRUMENTS THAT STAY ACCURATE

CUSTOMER SERVICE



NOTES:

1. UNLESS OTHERWISE SPECIFIED. RESISTORS IN OHMS, 1/4W, 5%; CAPACIT
2. ▽ DENOTES ANALOG GROUND
   ↓ DENOTES DIGITAL GROUND
3. SWITCHES SHOWN IN FULLY CCW POSITION (200Ω)
4. D104 & D105 ARE A MATCHED PAIR.

FIGURE 3-14. SCHEMATIC

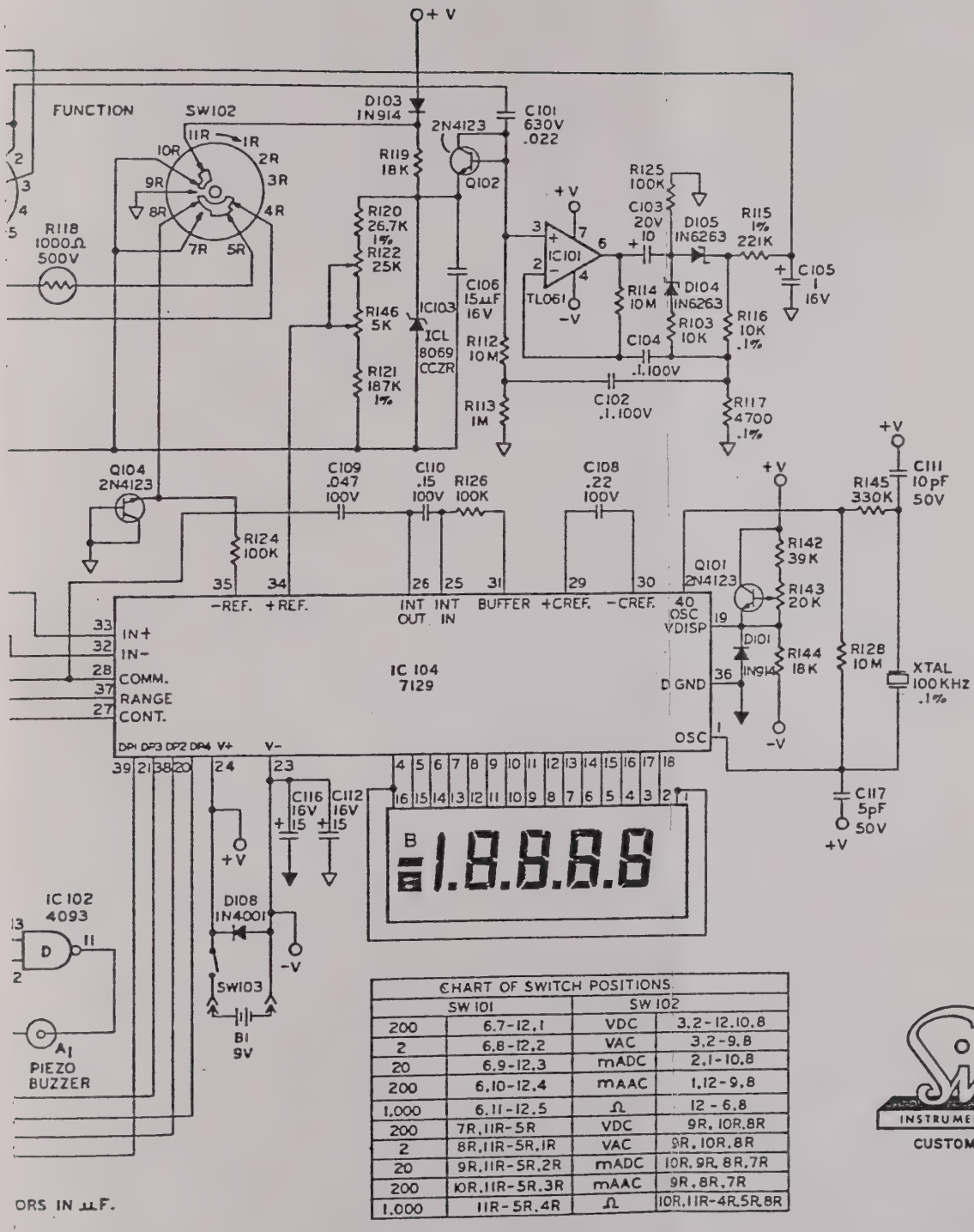


CHART OF SWITCH POSITIONS			
SW 101		SW 102	
200	6,7-12,1	VDC	3,2-12,10,8
2	6,8-12,2	VAC	3,2-9,8
20	6,9-12,3	mADC	2,1-10,8
200	6,10-12,4	mAAC	1,12-9,8
1,000	6,11-12,5	Ω	12-6,8
200	7R,11R-5R	VDC	9R,10R,8R
2	8R,11R-5R,1R	VAC	9R,10R,8R
20	9R,11R-5R,2R	mADC	10R,9R,8R,7R
200	10R,11R-5R,3R	mAAC	9R,8R,7R
1,000	11R-5R,4R	Ω	10R,11R-4R,5R,8R

ORS IN µF.

Simpson
INSTRUMENTS THAT STAY ACCURATE
CUSTOMER SERVICE

SIMPSON ELECTRIC COMPANY
853 DUNDEE AVENUE
ELGIN, ILLINOIS 60120
PHONE 697-2260

DIGITAL/OSCILLOSCOPE/SPECIAL PRODUCTS

M474 4.5 DIGIT HAND HELD DMM 1984-

PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
	PC & READOUT BOARD ASSEMBLY MODEL 474		
06-113157	RES 100K 1.0W 10%	R101	
05-119931	RES 1K 3.0W 5.0%	R102	
05-118161	RES 10K 1/4W 5.0%	R103	
05-114984	RES 56OK 1/4W 5.0%	R104	
06-113148	RES SPCL M474	R105	
06-112239	RES 99.8 OHM 1/4W 1.0%	R106	
05-116272	RES 90.0 OHM 1/4W .25%	R107	
05-118410	RES 9.0 OHM 1.0W .5%	R108	
06-112823	RES .9-.008 OHM	R109	
05-118168	RES 100K 1/4W 5.0%	R110	
05-118305	RES 1.0 MEG 1/4W 5.0%	R111	
05-116632	RES 10.0 MEG 1/4W 5.0%	R112	
05-118305	RES 1.0 MEG 1/4W 5.0%	R113	
05-116632	RES 10.0 MEG 1/4W 5.0%	R114	
05-117526	RES 221K 1/4W 1.0%	R115	
06-112821	RES 10K 1/4W .1%	R116	
06-112820	RES 4.7K 1/4W .1%	R117	
06-112329	RES 1K M474 SPCL	R118	
05-119644	RES 18K 1/4W 5.0%	R119	
06-113159	RES 26.7K 1/4W 5.0%	R120	
06-113158	RES 187K 1/4W 1.0%	R121	
06-113151	POT 25K .5W 20%	R122	
05-118169	RES 470K 1/4W 5.0%	R123	
05-118168	RES 100K 1/4W 5.0%	R124	
05-118168	RES 100K 1/4W 5.0%	R125	
05-118168	RES 100K 1/4W 5.0%	R126	
05-118168	RES 100K 1/4W 5.0%	R127	
06-113070	RES 10.0 MEG 1/8W 5.0%	R128	
06-112829	RES .01 OHM 1.0W .5%	R129	
05-118168	RES 100K 1/4W 5.0%	R130	
05-118168	RES 100K 1/4W 5.0%	R131	
05-118305	RES 0.1 MEG 1/4W 5.0%	R132	
05-118305	RES 0.1 MEG 1/4W 5.0%	R133	
06-111124	RES 240K 1/4W 5.0%	R134	
05-118305	RES 1.0 MEG 1/4W 5.0%	R135	
05-118305	RES 1.0 MEG 1/4W 5.0%	R136	
05-118305	RES 1.0 MEG 1/4W 5.0%	R137	

* ITEM AVAILABLE FROM FACTORY DISTRIBUTION CENTER

SIMPSON ELECTRIC COMPANY
853 DUNDEE AVENUE
ELGIN, ILLINOIS 60120
PHONE 697-2260

DIGITAL/OSCILLOSCOPE/SPECIAL PRODUCTS

M474 4.5 DIGIT HAND HELD DMM 1984-

PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
05-118305	RES 1.0 MEG 1/4W 5.0%	R138	
05-118305	RES 1.0 MEG 1/4W 5.0%	R139	
05-118305	RES 1.0 MEG 1/4W 5.0%	R140	
05-118305	RES 1.0 MEG 1/4W 5.0%	R141	
05-118166	RES 39K 1/4W 5.0%	R142	
06-112244	POT 20K .5W 20%	R143	
05-119644	RES 18K 1/4W 5.0%	R144	
06-113251	RES 330K 1/3W 5.0%	R145	
06-112275	POT 5K .5W 20%	R146	
06-112832	CAP .022UF 630V 10%	C101	
06-113162	CAP .1 UF 100V 10%	C102	
06-110306	CAP 10.0 UF 20V 20%	C103	
06-113162	CAP .1 UF 100V 10%	D104	
05-115531	CAP 1.0 UF 16V 10%	C105	
06-113031	CAP 15.0 UF 16V 20%	C106	
06-113154	CAP .033UF 100V 10%	C107	
06-113283	CAP .22 UF 100V 10%	C108	
06-113153	CAP .047UF 100V 10%	C109	
06-113152	CAP .15 UF 160V 2.5%	C110	
05-119319	CAP 10.0 UF 50V 10%	C111	
06-113031	CAP 15.0 UF 16V 20%	C112	
01-115832	CAP 470.0 UF 500V 10%	C113	
06-113162	CAP .1 UF 100V 10%	C114	
06-113161	CAP .022UF 100V 10%	C115	
06-113031	CAP 15.0 UF 16V 20%	C116	
06-113252	CAP 5.0 PF 50V 10%	C117	
06-113231	DIODE 1N6263	D101	
05-112004	DIODE 1N914	D102	
05-112004	DIODE 1N914	D103	
03-813018	DIODE M474 MATCHED PAIR	D104	
03-813018	DIODE M474 MATCHED PAIR	D105	
05-113826	DIODE 1N5059	D106	
05-113826	DIODE 1N5059	D107	
05-113200	DIODE 1N4001	D108	
06-110694	MOV	MOV101	
06-110694	MOV	MOV102	
06-110694	MOV	MOV103	
06-110694	MOV	MOV104	
05-115931	TRANS 2N4123	Q101	

* ITEM AVAILABLE FROM FACTORY DISTRIBUTION CENTER

SIMPSON ELECTRIC COMPANY
853 DUNDEE AVENUE
ELGIN, ILLINOIS 60120
PHONE 697-2260

DIGITAL/OSCILLOSCOPE/SPECIAL PRODUCTS

M474 4.5 DIGIT HAND HELD DMM 1984-

PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
05-115931	TRANS 2N4123	Q102	
05-113864	TRANS MPS3702	Q103	
05-115931	TRANS 2N4123	Q104	
05-115931	TRANS 2N4123	Q105	
05-115931	TRANS 2N4123	Q106	
06-113008	IC TL061CP	IC101	
06-112216	IC CD4093	IC102	
06-113156	IC ICL8069CCZR	IC103	
06-113034	IC ICL7129	IC104	
06-112215	IC CD4053	IC105	
06-112215	IC CD4053	IC106	
06-113155	CRYSTAL 100KHZ	X101	
03-261083	BEZEL READOUT	M470 SERIES	
06-112211	CONNECTOR ZEBRA STRIP		
06-113429	CONNECTOR STRIP INSULATED		
06-113146	LCD DISPLAY MODEL 474		
	CASE PARTS & MISC.		
10-865026	CASE TOP BRN	M470 SERIES	
10-865025	CASE TOP GRAY	M470 SERIES	
10-865024	CASE BOTTOM BRN	M470 SERIES	
10-865023	CASE BOTTOM GRAY	M470 SERIES	
10-560327	COVER BATT/FUSE BRN	470 SERIES	
10-560326	COVER BATT/FUSE GRY	470 SERIES	
10-865019	BAIL ASSEM BRN	M470 SERIES	
10-865018	BAIL ASSEM GRAY	M470 SERIES	
06-112988	PANEL OVERLAY LOWER	M474 BRN	
06-112835	PANEL OVERLAY LOWER	M474 GRAY	
06-113098	PANEL OVERLAY UPPER	M474 BRN	
06-113097	PANEL OVERLAY UPPER	M474 GRAY	
10-865021	KNOB SW WHEEL BRN	M470 SERIES	
10-865020	KNOB SW WHEEL GRAY	M470 SERIES	
06-112877	CVR-KNOB/SW BRN	M470 SERIES	
06-112878	CVR-KNOB/SW GRAY	M470 SERIES	
06-132900	SCREW 2-56 X 3/16		
06-112814	BUMPER BATT COVER	M470 SERIES	
06-112888	BUMPER CASE BTM		
06-112887	BUMPER BAIL ASSEM	M470 SERIES	
10-864958	TRANSDUCER ASSEM	M470 SERIES	

* ITEM AVAILABLE FROM FACTORY DISTRIBUTION CENTER

SIMPSON ELECTRIC COMPANY
853 DUNDEE AVENUE
ELGIN, ILLINOIS 60120
PHONE 697-2260

DIGITAL/OSCILLOSCOPE/SPECIAL PRODUCTS

M474 4.5 DIGIT HAND HELD DMM 1984-

PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
03-261130	HOUSING TRANSDCR BTM		
03-220086	WASHER SPRING RETAINER		
01-112911	FUSE 2.0 AMP 250V 3AG	F1	
06-110906	FUSE 3.0 AMP 600V BBS	F2	
06-112825	SW 5 PCS RANGE	M470 SERIES	SW101
06-112824	SW 5 PCS FUNCTION	M470 SERIES	SW102
06-112827	SW SPDT SLIDE TYPE	M470 SERIES	SW103
06-112833	SWITCH SHAFT		
05-181478	NUT #4-40		
01-181852	LOCKWASHER #4 SPLIT		
03-261138	FILLER SLIDE SWITCH		
06-113024	MASK SLIDE SWITCH		
06-113121	CABLE 7 CONDUCTOR		
06-111244	CONNECTOR BATTERY		
06-112816	CONNECTOR 2 CIRCUIT		
06-112837	JUMPER MOLDED	M470 SERIES	
06-112981	SHIELD		
10-865095	SPACER SHIELD ASSEM		
06-132902	SCREW #4-40 X .234		
06-132903	SCREW #4-40 X .475		
06-113165	SCREW #6-32 X 1/2		
05-130754	SCREW #2-56 X 3/16 PLASTIC		
05-134674	SCREW #2-56 X 5/16 LG		
01-182949	NUT HEX #2-56		
01-401859	LOCKWASHER #2		
06-112885	LABEL FUSE & BATT	M470 SERIES	
06-113388	LABEL WARNING	M474	
06-113168	INSTRUCTION MANUAL	M474	
00043	TEST LEADS		

* ITEM AVAILABLE FROM FACTORY DISTRIBUTION CENTER

www.manualsplus.com
1034635